# Subsets and Subspaces

Refer to Vocabulary for definitions.

A subspace **MUST** include the zero vector.

# Set Builder Notation

Say you want to create a set with matrixes in $\mathbb{R}^2$ such that the top element $\times$ the bottom element $= 0$.
Writing out each element is not only impractical, but impossible.
Hence we use set builder notation,

$$\left\{\text{matrix in } \mathbb{R}^2 \text{ such that the top element } \times \text{ the bottom element } = 0\right\}$$

$$\left\{\text{matrix} \in \mathbb{R}^2 \mid \text{ the top element } \times \text{ the bottom element } = 0\right\}$$

$$\boxed{\left\{\begin{bmatrix} a \\ b \end{bmatrix} \in \mathbb{R}^2 \mid a \times b = 0\right\}}$$

Is $v = \left\{\begin{bmatrix} a \\ b \end{bmatrix} \in \mathbb{R}^2 \mid a \times b = 0\right\}$ a subspace?

$\begin{bmatrix} 0 \\ 1 \end{bmatrix}, \begin{bmatrix} 1 \\ 0 \end{bmatrix} \in v$ but $\begin{bmatrix} 0 \\ 1 \end{bmatrix} + \begin{bmatrix} 1 \\ 0 \end{bmatrix} \notin v$ So $v$ is **not** a subspace.